

The Astrobiology of the Subsurface: Exploring Cave Habitats on Earth, Mars and Beyond

We are using the spectacular underground landscapes of Earth caves as models for the subsurfaces of other planets. Caves have been detected on the Moon and Mars and are strongly suspected for other bodies in the Solar System including some of the ice covered Ocean Worlds that orbit gas giant planets. The caves we explore and study include many extreme conditions of relevance to planetary astrobiology exploration including high and low temperatures, gas atmospheres poisonous to humans but where exotic microbes can flourish, highly acidic or salty fluids, heavy metals, and high background radiation levels.

Some cave microorganisms eat their way through bedrock, some live in battery acid conditions, some produce unusual biominerals and rare cave formations, and many produce compounds of potential pharmaceutical and industrial significance. We study these unique lifeforms and the physical and chemical *biosignatures* that they leave behind. Such traces can be used to provide a “Field Guide to Unknown Organisms” for developing life detection space missions.